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In re application of
K. Mori, et al.

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Title: Electrode Structure

DECLARATION

I, Tatsuya Ogawa, do hereby depose and state the following:

1. I reside at 26-5, Maenocho 4-chome, Itabashi-ku, Tokyo, Japan.

2. I received a bachelors degree in engineering on March 20, 1987, from Osaka Institute of Technology, Osaka, Japan.

3. I have been employed at Kyodo Printing Co., Ltd., 14-12, Koishikawa 4-chome, Bunkyo-ku, Tokyo, Japan, as a development engineer, since April 1, 1987.

4. The following tests were conducted by me or under my direct supervision:

1. TESTS TO DETERMINE EFFECT OF GLASS TRANSITION TEMPERATURE OF DIELECTRIC MATERIALS USED TO MANUFACTURE ELECTRODE STRUCTURES, AND CONJUGATE ANGLE OF BENDING PROCESSED PORTIONS OF THE ELECTRODES, ON GENERATION OF CRACKS DURING MANUFACTURING PROCESS

Tests were carried out, and evaluation of the results thereof evaluated, so as to determine

the extent of the generation of cracks in the bending processed portions of electrode structures of the present invention when the bending processed portions were formed by the compression molding of the supports (insulating bases) coated respectively with dielectric materials having glass transition temperatures of 85, 67, 45, 40, 35, 25, 5, 2, -20 and -29°C, respectively.

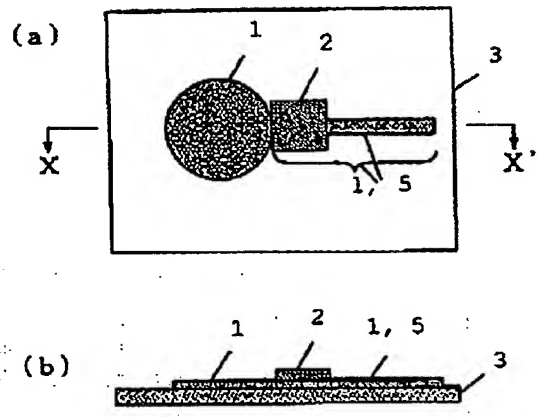
In particular, the ten (10) different types of electrode structures were constructed, designated as Examples 1-5, and Comparative Examples 1-5, as follows:

A.METHOD OF PREPARATION OF EXAMPLE ELECTRODE STRUCTURES 1-5, AND COMPARATIVE EXAMPLE ELECTRODE STRUCTURES 1-5:

Example 1:

As shown in Figures 1(a) and 1(b) below, thirty six (36) electrode structures were manufactured by, on an insulated aluminum film formed as the support 3, laminating a 38 μm thick polyester film on a 50 μm thick aluminum plate. Then, an about 20 μm thick carbon paste layer was formed as a terminal portion 5 on the support 3 by coating same with the aid of the screen printing. Thereafter, as an electrode layer 1, a circular form of 40 μm thick silver paste layer with a silver content of 90%(w/w) was formed on the support 3 by coating support 3 so as to partially overlap with the terminal portion 5.

Fig. 1

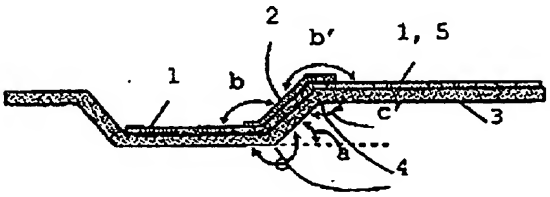


After drying, a 15 μm thick layer of a dielectric material having a glass transition temperature of 25°C (a polyester based resin with the brand name of VYLON GK150®, manufactured by Toyobo Co., Ltd.) was formed as an insulating layer by coating with the aid of the screen printing method, so as to partially cover the terminal portion 5.

The electrode structures manufactured according to Example 1 described above were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 below. In particular, eighteen (18) electrode structures were formed with a conjugate angle of 230°, and eighteen (18) electrode structures were formed with a conjugate angle of 250°. The generation

of cracks formed in the bending processed portions 4 of each of the thirty six (36) separate structures at the time of molding of each was then evaluated, as described below.

Fig. 2



Example 2:

Thirty six (36) electrode structures were formed as described in Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3220®, manufactured by Unichika, Ltd.) had a glass transition temperature of 5°C. The electrode structures manufactured according to Example 2, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding was then evaluated, as described below.

Example 3:

Thirty six (36) electrode structures were formed as described in Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3221®, manufactured by Unichika, Ltd.) had a glass transition temperature of 2°C. The electrode structures manufactured according to Example 3, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding were then evaluated, as described below.

Example 4:

Thirty six (36) electrode structures were formed as described in Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3400®, manufactured by Unichika, Ltd.) had a glass transition temperature of -20°C. The electrode structures manufactured according to Example 4, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding were then evaluated, as described below.

Example 5:

Thirty six (36) electrode structures were formed as described in Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3221®, manufactured by Unichika, Ltd.) had a glass transition temperature of -29°C. The electrode structures manufactured according to Example 5, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding were then evaluated, as described below.

Comparative Example 1:

Similarly to Example 1 discussed above, thirty six (36) electrode structures were manufactured by first printing silver paste on an insulated aluminum film (a film formed by laminating PET on an aluminum plate). Thereafter, after drying, a 15 μm thick layer of a dielectric material having a glass transition temperature of 85°C (a polyester based resin with the brand name of ELITEL UE3690®, manufactured by Unichika Ltd.) was formed on the silver coated electrode structures by coating same on the electrode structures using screen printing techniques.

Further, similarly to Example 1 described above, the laminated electrode structures thus obtained were then subjected to compression molding, and the generation of cracks there for each

was evaluated. In particular, eighteen (18) electrode structures were formed with a conjugate angle of 230°, and eighteen (18) electrode structures were formed with a conjugate angle of 250°. The generation of cracks formed in the bending processed portions 4 of each of the thirty six (36) separate structures at the time of molding of each was then evaluated, as described below.

Comparative Example 2:

Thirty six (36) electrode structures were manufactured as described in Comparative Example 1 above. However, the dielectric material used (a polyester based resin having the brand name Vylon GK200®, manufactured by Toyobo Co., Ltd.) had a glass transition temperature of 67°C. The electrode structures manufactured according to Comparative Example 2, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding were then evaluated, as described below.

Comparative Example 3:

Thirty six (36) electrode structures were manufactured as described in Comparative Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3210®, manufactured by Unichika Ltd.) had a glass transition temperature of 45°C. The electrode structures manufactured according to Comparative Example 3, as described above, were then subjected to compression molding, and a depression was thereby formed, as

shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding for each structure was then evaluated, as described below.

Comparative Example 4:

Thirty six (36) electrode structures were manufactured as described in Comparative Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3240®, manufactured by Unichika Ltd.) had a glass transition temperature of 40°C. The electrode structures manufactured according to Comparative Example 4, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding for each structure was then evaluated, as described below.

Comparative Example 5:

Thirty six (36) electrode structures were manufactured as described in Comparative Example 1 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3500®, manufactured by Unichika Ltd.) had a glass transition temperature of 35°C. The electrode structures manufactured according to Comparative Example 5, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding for each structure was then evaluated, as described below.

B. RESULTS OF EVALUATIONS PERFORMED ON EXAMPLES 1-5, AND COMPARATIVE EXAMPLES 1-5:

As mentioned above, the electrode structures manufactured according to Examples 1-5, and Comparative Examples 1-5, as described above, were each evaluated to determine the number of cracks formed therein, by visually counting the cracks formed therein. The results of these evaluations are shown below in Table 1:

Table 1

	Tg (°C)	Processing angle (Conjugate angle)	
		230°	250°
Comparative example 1	85	18/18	18/18
Comparative example 2	67	18/18	18/18
Comparative example 3	45	18/18	18/18
Comparative example 4	40	18/18	18/18
Comparative example 5	35	18/18	18/18
Example 1	25	2/18	17/18
Example 2	5	0/18	16/18
Example 3	2	0/18	12/18
Example 4	-20	0/18	0/18
Example 5	-29	0/18	0/18

(Number of cracked specimens/total number)

As illustrated in Table I above, none of the electrode structures according to the present invention, designated as Examples 2-5, having a conjugate angle of 230°, and comprising dielectric materials having a glass transition temperature of 5 to -29°C, exhibited cracks among the total number of 18 electrode structures. Further, in the case of the electrode structure of the present invention designated as Example 1, which comprised a dielectric material having a glass transition temperature of 25°C, cracks were only generated in two out of the eighteen test examples. Moreover, in the case of electrode structures having a conjugate angle of 250°, only electrode structures of the present invention (Examples 4 and 5), comprising dielectric materials having a glass transition temperature of -20 to -29°C, exhibited no cracks.

II. TESTS TO DETERMINE EFFECT OF PRESENCE/ABSENCE OF CARBON IN PASTE USED TO MANFACUTURE ELECTRODE TERMINAL PORTIONS OF ELECTRODE STRUCTURES

Tests were carried out to determine the effect of the composition of the paste used to form the electrode terminal portions of electrode structures on crack generation. In particular, two additional types of electrode structures, designated as Comparative Examples 6 and 7, were manufactured using silver-containing pastes according to the process described below, and the

amount of cracks generated therein compared to the electrode structures of Examples 1 and 2 (containing carbon pastes) described above, as follows:

A. METHOD OF PREPARATION OF COMPARATIVE EXAMPLE ELECTRODE STRUCTURES 6 AND 7:

Comparative Example 6

As shown in Figure 1 above, an insulated aluminum film formed as the support 3 was formed by laminating a 38 μm thick polyester film on a 50 μm thick aluminum plate. Then, an about 20 μm thick silver paste layer having a silver content of 90%(w/w) was coated thereon using screen printing, so as to form a terminal portion 5. Thereafter, an electrode layer 1 was formed, by forming a circular form of 40 μm thick layer of the above-mentioned silver paste, so as to partially overlap with the terminal portion 5.

After drying of the above layers, an insulating layer was formed, by coating a 15 μm thick layer of a dielectric material having a glass transition temperature of 25°C (a polyester based resin with the brand name of VYLON GK150®, manufactured by Toyobo Co., Ltd.), via screen printing, on the support 3, so as to partially cover the terminal portion 5. A laminated electrode structure was thus obtained.

This electrode structure was then subjected to compression molding, and a depression was thereby formed therein, as shown in Figure 2 above. This was performed so as to form eighteen (18)

sample electrode structures. The generation of cracks formed in the bending processed portions 4 of same at the time of molding for each structure was then evaluated, as described below.

Comparative Example 7:

Eighteen (18) electrode structures were manufactured as described in Comparative Example 6 above. However the dielectric material used (a polyester based resin having the brand name ELITEL UE3220®, manufactured by Unichika Ltd.) had a glass transition temperature of 5°C. The electrode structures manufactured according to Comparative Example 7, as described above, were then subjected to compression molding, and a depression was thereby formed, as shown in Figure 2 above. The generation of cracks formed in the bending processed portions 4 at the time of molding for each structure was then evaluated, as described below.

B. RESULTS OF EVALUATIONS PERFORMED ON EXAMPLES 1-5, AND COMPARATIVE EXAMPLES 6-10:

As shown in Table 2 below, in the case of electrode structures formed with a conjugate angle of 250°, in which carbon was used for the bending processed portions, as in Examples 1 and 2 discussed above (and as shown again below), no cracks were found to be generated in some electrode structures even for the cases of the dielectric materials having a glass transition temperature of 25°C or 5°C. In contrast, for the electrode structures in which no carbon is used, i.e., the electrode structures of Comparative Examples 6 and 7, which were comprised of silver-containing paste, cracks were observed in all of the examples.

Table 2

	Presence/absence of carbon	Tg (°C)	Processing angle (Conjugate angle)
			250°
Comparative example 6	Absent	25	18/18
Comparative example 7	Absent	5	18/18
Example 1	Present	25	17/18
Example 2	Present	5	16/18

Number of cracked specimens/total number

I hereby declare that all statement made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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14th MAY 2008

Date